



(11) **EP 1 862 669 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**05.12.2007 Bulletin 2007/49**

(51) Int Cl.:  
**F02M 61/14 (2006.01) F02M 61/16 (2006.01)**

(21) Application number: **06011399.0**

(22) Date of filing: **01.06.2006**

(84) Designated Contracting States:  
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR**  
Designated Extension States:  
**AL BA HR MK YU**

(71) Applicant: **SIEMENS AKTIENGESELLSCHAFT**  
**80333 München (DE)**

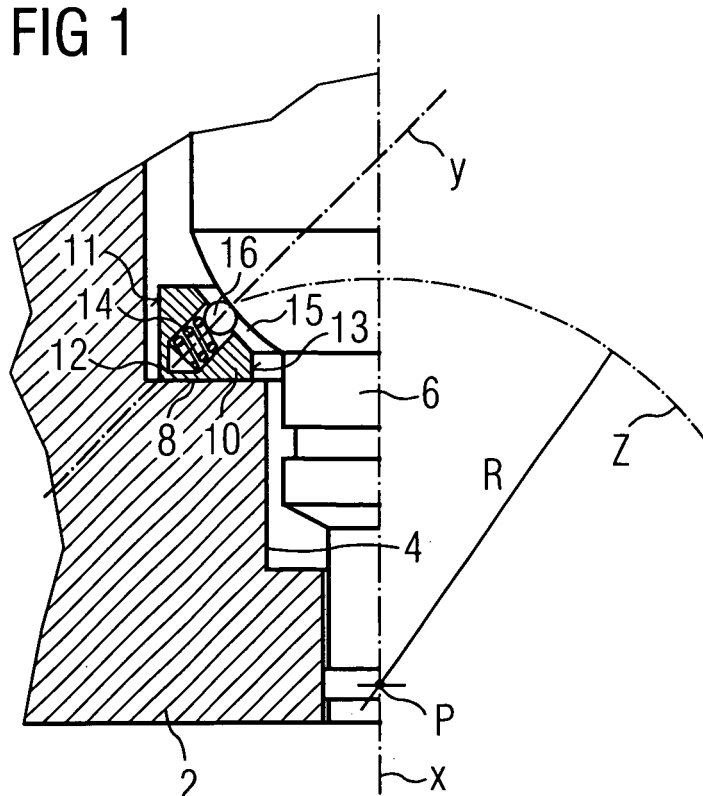
(72) Inventor: **Ricci, Roberto**  
**57121 Livorno (IT)**

(54) **Compensation device and cylinder head arrangement**

(57) A compensation device comprises a ring-shaped body (10). The ring-shaped body (10) has an inner side (13) facing towards a center of the ring-shaped body (10) and an outer side (11) facing away from the center of the ring-shaped body (10). At least a beveled

part (15) of the inner side (13) includes an acute angle with an axis (X) of the ring-shaped body (10). At least three flexible elements protrude from the beveled part (15) and are distributed around the circumference of the ring-shaped body (10).

**FIG 1**



## Description

**[0001]** The invention relates to a compensation device comprising a ring-shaped body. The ring-shaped body has an inner side facing towards the center of the ring-shaped body and an outer side facing away from the center of the ring-shaped body. Further, the invention relates to a cylinder head arrangement. The cylinder head arrangement comprises the compensation device, a cylinder head with a recess, and an injector. The recess of the cylinder head comprises an injector seat for the injector. The injector is arranged in the recess of the cylinder head.

**[0002]** EP 1 262 652 A1 discloses a cylinder head and an injector which is arranged at the cylinder head. The injector is clamped against the cylinder head at least at one clamping area of the injector. At the clamping area, between the injector and the cylinder head, a dumping element is arranged which is generally formed by one of the materials, for example, graphite, polyformaldehyde, polytetrafluorethylen, memory metal.

**[0003]** It is an object of the invention to create a compensation device and a cylinder head arrangement which enables a proper flexible coupling of the injector to the cylinder head.

**[0004]** The object of the invention is achieved by the features of claim 1 and claim 5. Advantageous embodiments of the invention are given in the sub-claims.

**[0005]** The invention is distinguished concerning a first aspect of the invention by a compensation device. The compensation device comprises a ring-shaped body. The ring-shaped body has an inner side facing towards the center of the ring-shaped body and an outer side facing away from the center of the ring-shaped body. At least a beveled part of the inner side includes an acute angle with an axis of the ring-shaped body. Further, the ring-shaped body has at least three flexible elements which protrude from the beveled part and which are distributed around the circumference of the ring-shaped body.

**[0006]** If the compensation device is arranged between an injector and an injector seat in a recess of an engine head, the injector may be tilted in such a way that an axis of the injector includes an acute angle with an axis of the recess and/or, respectively, with an axis of the ring-shaped body. Then, at least one of the flexible elements is preloaded and/or compressed by the injector while the other flexible element or, respectively, elements are relaxed while staying in good contact with the injector. So, the compensation device enables a proper flexible coupling of the injector to the cylinder head.

**[0007]** In a further advantageous embodiment of the first aspect of the invention, the flexible elements protrude from the ring-shaped body rectangular to the beveled part of the inner side of the ring-shaped body. This contributes to a proper compensation of the tilting of the injector.

**[0008]** In a further advantageous embodiment of the

first aspect of the invention, the ring-shaped body has at least three recesses which extend from the beveled part of the inner side into the ring-shaped body and which take in at least a part of the flexible elements. This contributes to a proper fixation of the flexible elements to the ring-shaped body.

**[0009]** In a further advantageous embodiment of the first aspect of the invention, each flexible element comprises a spring, which is arranged in each recess of the ring-shaped body, and a sphere which protrudes from each recess of the ring-shaped body and which is coupled to the spring. This contributes to a proper contact of the flexible element to the injector while having given flexibility of the injector in the recess of the cylinder head.

The given flexibility may be achieved by choosing the spring with a respective spring constant.

**[0010]** The invention is distinguished concerning a second aspect of the invention by a cylinder head arrangement which comprises the compensation device, the cylinder head, and the injector. The cylinder head has a recess. The recess of the cylinder head comprises an injector seat for the injector. The injector is arranged in the recess of the cylinder head. The compensation device or, respectively, a Belleville spring washer is circumferentially arranged around an axial section of the injector and between the injector and the injector seat.

**[0011]** The invention is explained in the following with the help of schematic drawings.

**[0012]** These are as follows:

Figure 1 a first embodiment of a cylinder head arrangement,

Figure 2 a second embodiment of the cylinder head arrangement.

**[0013]** Elements with the same design or function that appear in the different illustrations are identified by the same reference characters.

**[0014]** An internal combustion engine comprises a cylinder head arrangement (figure 1). The cylinder head arrangement comprises a cylinder head 2 and an injector 6. The injector 6 is arranged in a recess 4 of the cylinder head 2. The recess 4 of the cylinder head 2 comprises an injector seat 8 for the injector 6.

**[0015]** A compensation device preferably comprises a ring-shaped body 10. The ring-shaped body 10 is arranged between the injector 6 and the cylinder head 2, in particular, between the injector 6 and the injector seat 8 of the cylinder head 2. The ring-shaped body 10 has an inner side 13 and an outer side 11. The inner side 13 is facing towards an axis X of the injector 6 while the outer side 11 of the ring-shaped body 10 is facing away from the axis X of the injector 6. The inner side 13 comprises a part which has a surface which is parallel to the axis X and a beveled part 15 which includes an acute angle with the axis X of the injector 6.

**[0016]** Further, the ring-shaped body 10 comprises at

least three flexible elements. Preferably, the flexible elements are arranged at the beveled part 15 of the ring-shaped body 10. The flexible elements are distributed around the circumference of the ring-shaped body 10. For example, the ring-shaped body 10 comprises three non-overlapping angular ranges, with every angular range comprising at least one of the flexible elements. Preferably, the flexible elements are distributed around the circumference of the ring-shaped body with an angular distance of about 120 degrees.

**[0017]** Because of system tolerances, it is not always possible to arrange the injector 6 in the recess 4 of the cylinder head 2 in such a way that the axis X of the injector 6 is parallel to an axis of the recess 4 of the cylinder head 2. In other words, the injector 6 may be tilted respectively the axis of the recess 4 of the cylinder head 2.

**[0018]** If the injector 6 is tilted relative to the axis of the recess 4 of the cylinder head 2, at least one of the flexible elements is compressed and/or preloaded. At least one of the other flexible elements is relaxed without losing the contact to the injector 6. So, the injector 6 is arranged very flexible in the recess 4 of the cylinder head 2 while having a proper coupling to the cylinder head 2. In other words, the injector 6 may be turned around a center P with a radius R along a circumference Z in a small angular range without losing the contact to the cylinder head 2 via the compensation device which comprises the ring-shaped body 10.

**[0019]** The flexible elements may be made of single pieces of rubber. Preferably, the flexible elements comprise a spring 14 and a sphere 16. Further, the ring-shaped body 10 comprises one recess 12 of the ring-shaped body 10 for each flexible element. The recesses 12 of the ring-shaped body 10 and the flexible elements are formed and arranged in such a way that the spring 14 is arranged in the recess 12 of the ring-shaped body 10 and the sphere 16 is arranged at least partly in the recess 12 of the ring-shaped body 10 while the sphere 16 is not able to fall apart from recess 12 of the ring-shaped body 10. Preferably, the recess 12 of the ring-shaped body 10 extends rectangular to a surface of the beveled part 15. The recesses 12 of the ring-shaped body 10 are distributed around the circumference of the ring-shaped body 10 with an angular distance of, preferably, 120 degrees.

**[0020]** In an alternative embodiment, the compensation device comprises Belleville spring washers 18 (figure 2). The Belleville spring washers 18 are arranged between the injector 6 and the cylinder head 2, in particular, between the injector 6 and the seat 8 of the cylinder head 2. The Belleville spring washers 18 enable the tilting of the injector 6 relative to the axis of the recess 4 of the cylinder head 2 while having a proper contact of the Belleville spring washers 18 to the injector 6. In order to keep the injector 6 in its position, a clamping element 20 is fixed by a screw 22 to the cylinder head 2. The clamping element 20 protrudes from the cylinder head 2 in such a way that the injector is clamped between the Belleville

spring washers 18 and the clamping element 20.

**[0021]** The invention is not restricted by the explained embodiments. For example, the embodiments may be combined. For example, the clamping element 20 and/or the screw 22 are arranged at the first embodiment of the cylinder head arrangement. Further, there may be an alternative device for the clamping element 20 and/or the screw 22 for keeping the injector 6 in its position. Further, the compensation device may comprise more flexible elements. Further, the flexible elements may have different angular distances to each other, for example, with four flexible elements, the preferred angular distance may be 90 degrees. Further, the flexible elements may solely comprise the spring 14. Further, there may be arranged more or less Belleville spring washers 18.

## Claims

1. Compensation device comprising a ring-shaped body (10) which has
  - an inner side (13) facing towards a center of the ring-shaped body (10) and an outer side (11) facing away from the center of the ring-shaped body (10), at least a beveled part (15) of the inner side (13) including an acute angle with an axis (X) of the ring-shaped body (10),
  - at least three flexible elements which protrude from the beveled part (15) and which are distributed around the circumference of the ring-shaped body (10).
2. Compensation device in accordance with claim 1 wherein the flexible elements protrude from the ring-shaped body (10) rectangular to the beveled part (15) of the inner side (13) of the ring-shaped body (10).
3. Compensation device in accordance with one of the preceding claims wherein the ring-shaped body (10) has at least three recesses (12) which extend from the beveled part (15) of the inner side (13) into the ring-shaped body (10) and which take in at least a part of the flexible elements.
4. Compensation device in accordance with one of the preceding claims wherein each flexible element comprises a spring (14) which is arranged in each recess (12) of the ring-shaped body (10) and a sphere (16) which protrudes from each recess (12) of the ring-shaped body (10) and which is coupled to the spring (14).
5. Cylinder head arrangement comprising
  - the compensation device according to one of the preceding claims or a Belleville spring wash-

er (18),

- a cylinder head (2) having a recess (4),  
- an injector (6) being arranged in the recess (4)  
of the cylinder head (2), the recess (4) of the  
cylinder head (2) comprising an injector seat (8)  
for the injector (6), with the compensation device  
or, respectively, the Belleville spring washer (18)  
being circumferentially arranged around an axial  
section of the injector (6) and between the injec-  
tor (6) and the injector seat (8).

5

10

15

20

25

30

35

40

45

50

55





European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 06 01 1399

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 3 038 456 A (DREISIN ALEXANDER) 12 June 1962 (1962-06-12) * abstract; figures 1-6 *	1,5	INV. F02M61/14 F02M61/16
X	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 12, 29 October 1999 (1999-10-29) & JP 11 200991 A (MITSUBISHI ELECTRIC CORP), 27 July 1999 (1999-07-27) * abstract *	1,5	
X	PATENT ABSTRACTS OF JAPAN vol. 2003, no. 01, 14 January 2003 (2003-01-14) & JP 2002 257239 A (TOYOTA MOTOR CORP; NOK CORP; NOK VIBRACOUSTIC KK), 11 September 2002 (2002-09-11) * abstract; figures 1-6,11 *	5	
X	PATENT ABSTRACTS OF JAPAN vol. 2003, no. 12, 5 December 2003 (2003-12-05) & JP 2006 037866 A (NISSAN MOTOR CO LTD), 9 February 2006 (2006-02-09) * abstract *	5	TECHNICAL FIELDS SEARCHED (IPC) F02M
X	PATENT ABSTRACTS OF JAPAN vol. 2003, no. 12, 5 December 2003 (2003-12-05) & JP 2004 301057 A (TOYOTA INDUSTRIES CORP), 28 October 2004 (2004-10-28) * abstract *	5	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 15 September 2006	Examiner Boye, Michael
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons &amp; : member of the same patent family, corresponding document</p>			

3  
EPO FORM 1503 03.82 (P04C01)



European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 06 01 1399

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 13, 30 November 1999 (1999-11-30) & JP 11 210885 A (MARUSAN:KK), 3 August 1999 (1999-08-03) * abstract *	5	
A	----- PATENT ABSTRACTS OF JAPAN vol. 1999, no. 13, 30 November 1999 (1999-11-30) & JP 11 210886 A (NOK CORP), 3 August 1999 (1999-08-03) * abstract *	5	
A	----- US 6 640 784 B1 (SIMS, JR. DEWEY MCKINLEY) 4 November 2003 (2003-11-04) * abstract *	1,5	
			TECHNICAL FIELDS SEARCHED (IPC)
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 15 September 2006	Examiner Boye, Michael
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	

3  
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 06 01 1399

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

15-09-2006

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 3038456	A	12-06-1962	NONE	
JP 11200991	A	27-07-1999	JP 3373418 B2	04-02-2003
JP 2002257239	A	11-09-2002	NONE	
JP 2006037866	A	09-02-2006	NONE	
JP 2004301057	A	28-10-2004	NONE	
JP 11210885	A	03-08-1999	NONE	
JP 11210886	A	03-08-1999	NONE	
US 6640784	B1	04-11-2003	NONE	



**REFERENCES CITED IN THE DESCRIPTION**

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

**Patent documents cited in the description**

- EP 1262652 A1 [0002]